13. STOCHASTIC DIFFERENTIAL EQUATIONS

Asymptotic Theory of Estimation in Nonlinear Stochastic Differential Equations for the Multiparameter Case

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Strong consistency and asymptotic normality of the m.l.e. for multi-dimensional parameters in nonlinear stochastic differential equations is proved, using Kolmogorov type inequalities from the theory of diffusion processes.

The Bernstein–Von Mises Theorem for a Certain Class of Diffusion Processes

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The Bernstein–von Mises theorem, showing that the posterior density, when properly normalized, converges to a normal density, is proved for a certain class of diffusion processes arising as solutions to non-linear stochastic differential equations. As an application, the m.l.e., and Bayes estimators for smooth loss functions and smooth priors, turn out to be asymptotically normal. The parameter space is assumed to be a compact subset of $\mathcal{R}^d$.

A Limit Theorem for Stochastic Ordinary Differential Equation in Homeomorphisms Group

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Consider a stochastic ordinary differential equation of the form

$$\frac{dx}{dt} = \frac{1}{\varepsilon} F\left(t, x, \frac{1}{\varepsilon^2}, w\right) + G\left(t, x, \frac{1}{\varepsilon^2}, w\right),$$

where F and G are random vector fields satisfying some conditions. The solution starting at x at time 0 denoted by ϕ_t^ε defines a stochastic flow of homeomorphisms. We show that the flow ϕ_t^ε converges weakly to a Brownian motion ϕ_t in the homeomorphisms group as $\varepsilon \to 0$ and that ϕ_t satisfies a stochastic differential equation based on a Brownian motion in the space of continuous vector fields, which can be regarded as the weak limit of the above ordinary differential equation.